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ABSTRACT TITLE: Modeling of particle flow due to ultrasonic drilling

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PRESENTATION - Oral Presentation

ABSTRACT TEXT

In-situ analysis and sample return is one of the major tasks in future NASA exploration missions. It is essential that the acquired samples and the samples returned from other planets including Mars are free of contaminations from the earth. Recently, a novel drilling technology that is actuated by a piezoelectric drive mechanism was developed and it is called Ultrasonic/Sonic Driller/Corer (USDC). This drill has an inherent capability to extract the formed drilling powder and thus address the critical issue of contamination. A modification of this USDC in the form of an Ultrasonic Rock Abrasion Tool (URAT) allows for the formation of pristine rock surface for analysis. An algorithm is being proposed for the reduction of the contamination that may be generated during the acquisition of the samples and particularly during the rock abrasion process. The algorithm provides information that could be used to control the flow of particles using programmed vibration characteristics and thus allow for smart flow of particles. The hypothesis is that the probability of a contamination left on the ground surface is exponentially inverse-proportional to the volume of the core ground into dusts. To support this hypothesis, we need to understand the flow pattern of the particles. A model proposed by Savage [1] is used to develop a finite difference program. Some preliminary results have been derived.

[1] Savage, S. B., "Streaming motions in a bed of vibrationally fluidized dry granular material", *J. Fluid Mech.*, Vol. 194, pp. 457-478, 1988.

KEYWORDS: Ultrasonic/sonic driller/corer (USDC), Particle flow in-situ sampling, ultrasonic drilling, planetary exploration, piezoelectric devices, Active Materials.

BRIEF BIOGRAPHY: Dr. Zensheu Chang is a Member of Engineering Staff at the NDE and Advanced Actuators (NDEAA) Team of the Jet Propulsion Laboratory. He received his Master of Science degree in 1988 from the Mechanical Engineering department, National Taiwan University, Taipei, Taiwan; and Ph.D. degree in 1997 from the Mechanical and Aerospace Engineering department, UCLA. His research areas include ultrasonic NDE/NDT, elastic wave propagation, mechanics of composite material structures, and FEM modeling. He has published more than 10 papers in related research areas.